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SURVEY OF BLACK STAIN ROOT DISEASE NEAR THE BIG BEAR RANGER STATION, SAN BERNARDINO NATIONAL FOREST

Melissa Marosy, Plant Pathologist

ABSTRACT

A survey was conducted of black stain root disease on pinyon pine near the Big Bear Ranger Station on the San Bernardino National Forest. The disease appears to be widespread in the western portion of the area surveyed. Thirty-six centers, encompassing approximately 9% of the survey area, were encountered along seven transect lines placed at 2-chain-wide intervals. Management alternatives are presented.

On December 12, 1989, Charles Irby, San Bernardino National Forest Supervisor, requested an intensive survey of black stain root disease on the Big Bear Ranger District of the San Bernardino National Forest, from the Cougar Crest trailhead parking lot east to the Stanfield Cutoff, to encompass the site of the proposed visitor center, one-quarter mile west of the Big Bear Ranger Station. The purpose of the evaluation was to identify and locate the black stain centers, examine causes for decline in western juniper, and provide management options based on current knowledge.

On July 10th and 12th, 1990, Melissa Marosy, plant pathologist, and John Dale, entomologist, conducted a survey of black stain root disease in pinyon pines in the area specified in the December 1989 request. The vegetation type is pinyon/juniper. Jeffrey pine is scattered among the pinyon and juniper, and mountain mahogany and manzanita are the predominant brush species. The survey focused on pinyon pine; however, dead and dying Jeffrey pine and juniper encountered were also examined.

BIOLOGY AND IMPACTS OF BLACK STAIN ROOT DISEASE

Black stain root disease is caused by the fungus Ophiostoma (Ceratocystis) wageneri (asexual state Leptographium wageneri). In California, the fungus has three host-specific strains that infect either ponderosa and Jeffrey pine, singleleaf pinyon pine, or Douglas-fir. The fungus which causes the disease in pinyon pine is referred to as L. wageneri var. wageneri. In those areas where it has been found attacking singleleaf pinyon pine no other conifers have been affected. In particular, western juniper, a tree commonly found in association with pinyon pine, is resistant to this disease. Hardwood trees and shrubs are also unaffected.

Initiation of disease centers probably occurs when spore-carrying, cambium-feeding beetles invade tree roots and transmit the spores of the fungus to the tree. The fungus then grows in the wood of the root toward the root collar. Once the fungus becomes established in a tree it spreads locally between trees through either rootlet contact or fungal growth through the soil for short distances, followed by direct infection of small feeder roots. The rate of spread within pinyon pine stands has been reported to be about 6.7 feet per year (Wagener and Mielke 1961).

The disease can be identified in a tree by the dark brown to black stain of the wood. This stain occurs as arcs that follow the annual rings. The amount of stain around the bole varies among trees. It may involve only a small part of the tree's circumference or it may encircle the tree. The stain may be superficial or one to many annual rings deep.

Infected trees undergo gradual to rapid crown decline prior to mortality. Symptoms of crown decline include reduced terminal growth, needle yellowing and shortening, and premature loss of foliage. Trees pole-size and larger may also bear a heavy cone crop. Bark and engraver beetles can successfully attack and kill infected trees.

Little information is available regarding the epidemiology of black stain root disease in pinyon pine.

SURVEY METHODS

Five transects were run on an east-west bearing at 2-chain intervals between the Cougar Crest trailhead (beginning 10 chains from the trailhead) and the drainage directly behind the Big Bear Ranger Station. Two additional transects were run east from this drainage to within 9 chains of the Stanfield Cutoff (transect #6) and 3 chains beyond the Cutoff (transect #7). Bearings were determined by hand-held compasses; distances were roughly measured by pacing.

Disease centers which were intersected by the transect lines were recorded. Disease centers were confirmed by cutting into the base of suspect infected trees to reveal the diagnostic black stain. Identity of the pathogen to species was confirmed by Ted Leininger and Mark Fenn (Forest Service Riverside Fire Laboratory) by isolation from samples of stained wood. At each confirmed disease center, notes were taken as to the location, size, and severity of the

center. A numbered metal tag was nailed to the west-facing side of a non-pinyon tree nearest to the plot center (the point at which the transect line intersected a disease center) (transects #2, #4, and #6), or to the nearest prominent tree close to the transect line on the side facing the plot center, as noted in the field notes (transects #1, #3, #5, and #7). The tagged trees were also marked with chartreuse flagging, to make them easier to spot from a distance.

To map the plot centers, actual linear distances between known starting and ending points of each transect line were determined from a base quad map (7.4 mm = 1 chain). Field data were then converted to actual chains using the conversion factor for each transect. For example, transect line #2 was known to begin on the Cougar Crest Trail, 8 chains from the trailhead, and end at the bottom of the draw behind the Big Bear Ranger Station. On the base map used, this distance = 300 mm. Given the scale of the map, this represents a distance of 40.5 chains. The rough distance recorded by the surveyor was 44 chains. Thus, the conversion factor used for the data collected along transect #2 was 0.92. Conversion factors for the other transects were as follows: transect #1 = 0.91 (first section) and 0.65 (second section), transect #3 = 0.84, transect #4 = 0.89, transect #5 = 1.04, transect #6 = 0.90, and transect #7 = 1.00.

RESULTS

A map of the transect lines, plot centers, and disease centers is presented in Figure 1. Thirty-six black stain root disease centers were encountered along the seven transect lines. The centers ranged in size from less than 1/10 acre to 1 1/2 acres, and consisted of from one single dead tree to over 30 dead and dying trees. Some of the centers had coalesced such that entire ridgetops appeared to be affected. Overall, black stain root disease was found on approximately 9% of the surveyed area. Disease incidence was not uniform throughout the survey area, however. Numerous disease centers were found in the area between the Cougar Crest trail and the Ranger Station, where almost 15% of the surveyed area was affected. Very little disease was found east of the Ranger Station, where less than 4% of the surveyed area was affected. This could be explained in part by the loss of pinyon pine as the predominant vegetation species and the existence of residences, roads, and trails in the eastern portion of the survey.

An occasional Jeffrey pine was noted with typical black stain root disease symptoms. L. wageneri was isolated from wood taken from one of these trees.

A number of fading western juniper were examined. Crown symptoms were typical of annosus root disease caused by Heterobasidion annosum; however, we were unable to find signs of this disease on the roots which we were able to expose using pulaskis and shovels. Our attempts to uproot a number of small symptomatic trees for a more extensive examination of the root systems were futile.

DISCUSSION

Black stain root disease is widespread in the pinyon pine north and west of the Big Bear Ranger Station, where almost 15% of the survey area is affected. Numerous old disease centers exist along with recently dead and dying trees. Many of the disease centers encountered are enlarging and coalescing.

Management alternatives for black stain root disease in areas of the San Bernardino such as the one surveyed include the following:

1. Do nothing. The disease centers will continue to enlarge and coalesce. Regeneration may survive over the short term, but as the saplings grow their roots will have an increased probability of encountering infected roots of adjacent trees and becoming infected themselves. Along with the juniper mortality occurring in this area, and the susceptibility of the associated Jeffrey pine to the black stain, an eventual loss of coniferous vegetative cover may be expected. Management objectives of maintaining coniferous vegetative cover on the site will not be met.

2. Remove dead and dying pinyon pine. Harvesting of the dead and dying trees for fuelwood or other purposes will more fully utilize the resources of the area, but will not affect the progress of the root disease.

3. Remove dead and dying pinyon pine plus a 75-foot buffer around each infection center. This treatment was suggested by DeNitto (1984), but has to date not been implemented. Such a treatment would result in more complete utilization with fewer entries, and might result in the disease dying out in the existing centers with no available living hosts to infect. While the approach has not yet been tested, such an extreme measure seems warranted in light of the results of Sharon and Johnson (1987), who attempted to control the spread of individual black stain disease centers in pinyon pine in Colorado. The three treatments used included (1) removal of all dead and diseased trees within the center plus the first row of healthy trees along the perimeter; (2) soil fumigation with Vapam; and (3) insertion of a polyethylene barrier within a trench around the disease center. None of these treatments was effective in controlling the spread of the disease. The primary problem encountered was the inability to accurately identify diseased trees which lacked visible symptoms. A 1978 survey (Wood 1978) of root disease centers on the north shore of Big Bear Lake, directly across Hwy 38 from the area covered in the present survey, identified only three black stain root disease centers, verses the 36 centers found in the present study. This difference in disease levels might suggest that Hwy 38 has acted as an effective buffer to prevent spread of the disease from the north to the south side of the highway. Still, total effectiveness of a wide buffer in preventing disease spread cannot be assured. In addition, even if spread of the disease in existing centers is stopped, the establishment of new centers cannot be prevented.

4. Convert to non-host species. Since black stain root disease caused by L. wageneri var. wageneri does not affect western juniper or Jeffrey pine, these species could be planted in place of the dead and dying pinyon

pines. Type conversion to a non-host species is an effective technique, but one that is not a viable option when pinyon pine is the principal coniferous species suited to the site. Conversion of the area in question to western juniper would not be wise in light of the unexplained decline currently occurring in that species. Conversion to Jeffrey pine would not be wise because of the apparent presence of the pine strain of the black stain pathogen, L. wageneri var. ponderosum. Furthermore, type conversion is not compatible with the management objectives for this site.

FPM would like to initiate an administrative study on the Big Bear Ranger District to answer questions such as the persistence of L. wageneri var. wageneri in the soil, the role of vectors in disease spread, potential risk-rating systems, and viable management options. The disease centers identified in this survey were marked on the ground, and their locations documented by detailed field notes, in such a way that they can be easily relocated for use in future studies. (Field notes are available upon request from R-5 Forest Pest Management.) The information collected regarding the current size of the centers and numbers of dead and dying trees will provide a baseline for future studies on spread of the disease.

Until such a study can be initiated, we suggest that a detailed inventory be made of the disease centers in the immediate vicinity of the proposed visitor center, and an effort be made to design the facility with these centers in mind. Declining western juniper should also be noted. A cause for the decline of western juniper associated with the pinyon pine was not readily apparent. Annosus root disease is known to be present on Jeffrey pine and western juniper in the vicinity of the Cougar Crest Trail (Wood 1978) and could cause the symptoms noted. To confirm this diagnosis, it will be necessary to uproot a symptomatic juniper in order to thoroughly examine the root system and collect root samples from which to attempt to isolate the fungus. If the district can arrange to have one or more symptomatic trees uprooted in the presence of one of our staff pathologists, such a diagnosis can be made. It is recommended that this be done prior to construction of the visitor center so that this root disease, if present, can be taken into consideration along with the black stain root disease already confirmed.

LITERATURE CITED

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